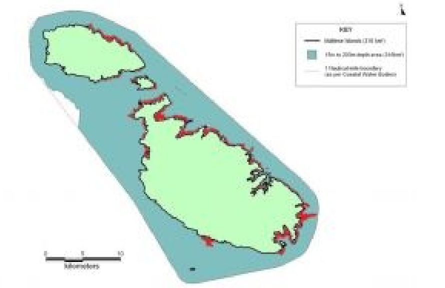
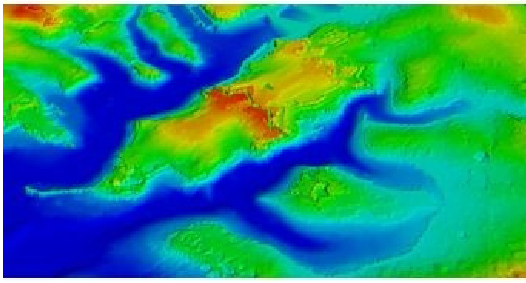
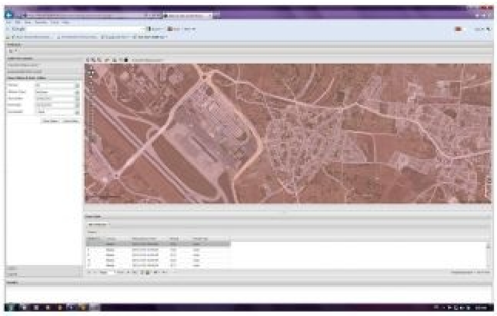
CAPTURING AN ENTIRE MALTESE ISLANDSÂ€™ TERRITORY

No More Spatial ÂMisinterpretation Using Different Technologies







Malta, the smallest European Union state, has carried out a country-wide hydrographic survey which was initiated in Q1 2012 and completed in Q4 of the same year. Aimed at acquiring baseline information that satisfies a number of key National and European Directives including the Water Framework Directive, the central Mediterranean state took the ambitious step of employing different technologies within one project in order to ensure compliance.

An inability to collect base physical data on which to build reliable thematic environmental data would not only make Malta more exposed to various environmental pressures due to poorly informed policy decisions, but also subjects the Islands to heavy economic penalties for non-compliance with EU reporting obligations. As part of the process to implement the EU legislative framework in the fields of air, water, noise, soil and radiation, Malta sought to enhance the quality of the environmental data and its interpretation. This depends to a large extent on the underlying spatial base data, as this underpins the operation of environmental monitoring programmes and is essential to the analytical and decision-making processes. This was deemed true for both terrestrial and bathymetric data acquisition related to environmental monitoring.

Data Dearths

A base study identified that whilst some basic bathymetric data was available from legacy nautical charts, such data needed to be updated to higher resolutions so as to be suitable for environmental modelling and EU reporting purposes. This was also the case for terrestrial high-definition data which were both lacking and where available in low resolution and dated currency. No comprehensive and detailed terrestrial and bathymetric 3D surveys have ever been carried out in Malta. The resulting lack of high-quality 3D spatial data was hindering land use planning, environmental monitoring and management processes that rely on such data. The target to address this lacuna was actuated through the delivery of high-resolution 3D terrestrial data coverage for the Maltese Islands using a combination of Light Detection and Ranging (Lidar) data and oblique aerial imagery, as well as through a bathymetric survey of coastal waters within 1 nautical mile (nm) radius off the coastline, using a combination of aerial Lidar surveys, acoustic scans and a physical grab sampling survey (Figure 1).

Acquisition Vehicle

This was made possible by implementing a EUR4.6 million project, entitled Developing National Environmental Monitoring Infrastructure and Capacity, a project co-financed by the European Regional Development Fund, which provides 85% of the project’s funding and the Government of Malta, which finances the remainder under Operational Programme 1 - Cohesion Policy 2007-2013 - Investing in Competitiveness for a Better Quality of Life. Whilst the project focused on strategies in the different environmental domains, the scans played a major role in acquiring the main baselines.

Aerial Conveyors

The four main activities emanating from this project were entrusted to Terraimaging, with subcontractors Pelydryn (UK) and AquaBioTech Group. The main acquisitions pertaining to the geo-information were comprised of 4 activities. Activities 1 and 2 targeted a terrestrial Lidar survey and imagery in addition to oblique imagery which rendered high-resolution data for land cover and land use analysis for forward planning. The Lidar exercise resulted in a DSM and DTM aimed at a 1 points/m² but actually resulted in a surprising 4.3 points/m² and a height accuracy > 5cm (Figure 2). This was enhanced by an image acquisition employing an IGI DigiCam with a GSD of 16cm, whilst the oblique imagery had a spatial resolution of 15cm and employed a VisionMap A3 camera.

Bathymetric Conveyors

Activity 3 comprised a bathymetric Lidar survey which was deemed necessary to ensure that the data lacunae experienced in the nether zone between the coast and the deeper sea as reached by boat-based surveys is captured. The requirements stipulated a minimum 5m overlap between bathymetric airborne Lidar and the swath bathymetric survey for quality assurance purposes as well as delivery of post-processed data in fulfilment of the IHO requirements. The technology used was based on HawkEye IIb (AHAB) that operated at 1Khz frequency for the bathymetric area and 8Khz for the topographic zones. Interestingly, what was originally requested up to a depth of 15m resulted in a 50m depth return with a post spacing of 2 x 2m (Figure 3). Data was delivered in ASCII XYZ format file and a DSM. The final activity, 4, consisted of an acoustic and bathymetric survey from a sea-going vessel. The main aim being the Water framework Directive specifying studies within 1 nautical mile from the Maltese baseline coastline, resulted in the need for a survey of the coastal water at 15m to 200m depths. The technology used was side sonar with ground truthing carried out to determine the type of sea bottom as well as grab samples being taken where the ground changes. This was required to ensure the collection and on-site visual analysis of the sediment samples.

Applications

The integration of the datasets and imagery into a homogenous spatial infrastructure can now allow for analysis and policy making in the realms of spatial planning and environmental protection due to its potential to create valley networks, watersheds, view sheds, line of sight, risk maps and a plethora of other outputs as well as aid in the planning of major projects such as offshore wind farms, wave energy generators and potentially land reclamation. In addition, nautical charts can now be created in high definition. Predictive planning and scenario building within the environmental domain is made possible through the integration of data on noise, air pollution and water runoff. The data will be disseminated free of charge post Q3 2013 on project closure through a Shared Environmental Information System (Figure 4).

Lessons Learnt

Lessons learnt from this project predominantly focus on the rapid changes experienced by technological change from project drafting to conclusion, to the client's benefit, and the potential for the integration of a huge dataset into a single system that spans multi-domains (physical-environmental-social, amongst others). Of course, one cannot ignore the difficulties encountered in managing a multi-thematic project that spans technologies and detailed requirements that few companies may be able to provide. The latter may result in project loss although the main positive aspect pertains to the potential for consortia to be set up, as effectively happened in Malta.

Planning the Next Steps

The next steps include a drive to rerun the bathymetric and terrestrial scan to enable change analysis, the commissioning of a street-level terrestrial Lidar scan in full colour as well as the commissioning of a ground-penetrating radar scan of the Maltese Islands which would ensure the completion of a full structural dataset covering the entire territory.

Further Reading

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- Formosa S., Sciberras, E., and Formosa Pace J., (2012), Taking the Leap: From Disparate Data to a Fully Interactive SEIS for the Maltese Islands in Murgante B., Gervasi O., Misra S., Nedjah N., Rocha A.M., Taniar D., and Apduhan B.O., (Eds.), Computational Science and its Applications – ICCSA 2012, LNCS 7334, Springer, Heidelberg, ISBN 978-3-642-31074-4
- Malta Environment & Planning Authority, (2009): *Developing National Environmental Monitoring Infrastructure and Capacity*, MEPA, Floriana, Malta

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